Spring 2021

ME 311-004: Thermodynamics I

Dibakar Datta

Spring 2021: ME 311 S004 Thermodynamics I

Department of Mechanical and Industrial Engineering
New Jersey Institute of Technology (NJIT)
Newark, NJ 07012, USA

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Class: Days/Times – Monday, Wednesday (9:00 AM – 10:20 AM); Credits – 3.00

Book	004	15426	Converged Learning	MW	09:00 AM - 10:20 AM	KUPF 118	Closed	39	39	Datta, Dibakar	Converged Learning Course https://www5.njit.edu/registrar/instructionaldelivery/	3

Prerequisites: Math 211- Calculus 111; Phys 111-Physics 1

Book: Yunus A. Cengel & Michael A. Boles; Thermodynamics - An Engineering Approach; 8th Edition; Published by McGraw-Hill Education

Method of Lectures/Communications:

- *Converged Learning Course:*

According to the NJIT website, ME 311 S001 is 'Converged Learning Course'. Students can come to the class or join the class online (WebEx).
https://www5.njit.edu/registrar/instructionaldelivery/

We will primarily use WebEx for online live lectures. NJIT provides WebEx access to all Highlanders. Please check the link for WebEx:
https://ist.njit.edu/webex

You can have personal access to WebEx :
https://njit.webex.com/webappng/sites/njit/dashboard?siteurl=njit

Sign-in with your UCID.

- *Recorded Lectures:*

I will also provide recorded lectures. Especially, if I miss any live lectures, you will get recorded lectures.

- *One-on-One Face-to-Face e-Meeting:*

Please feel free to contact me whenever you need to discuss anything. We will schedule a one-on-one e-meeting and discuss in detail.

Office Hours: There are no specific office hours. Please email me to schedule an appointment. We can e-meet in any day any time at our mutually convenient time.

Lecture Notes and Study Materials: We will NOT blindly follow this textbook. You will receive lecture notes/slides and additional study materials in every class. Moreover, you will be provided many videos for a clear understanding of the concept.

Office Hours: There are no specific office hours. Please email me to schedule an appointment. We can meet in any day at our mutually convenient time.

Course Description: Thermodynamic fundamentals. Introduction to the basic concept of energy and the laws governing the transfer and transformation of energy. Thermodynamic properties and the application of the first and second laws of thermodynamics in the analysis of closed and open systems. Availability analysis is introduced. These concepts are then integrated into the analysis of simple cycles.

Outcome of the course:

1. Identify the properties of real substances, such as water from tabular data, ideal gases from tabular data or equation of state and other real gases P,v,T, data through the use of the compressibility charts.
2. Analyze processes involving real substances and ideal gases as working fluid in both the open and closed systems, apply the first law, the conservation of mass to perform both mass and energy balances, sketch process diagrams, and to determine work and heat transfers.
3. Analyze open and closed systems through the application of the second law of thermodynamics as well as applying the energy concept.
4. Analyze some simple thermodynamic cycles.

Grading Policy:

(1) Homework (45%)

Typically, you will be assigned four/five homework problem sets. You will have around two weeks for each problem set.

(2) Two Mid-Term Examinations (35%)

All exams are take-home exam. You are allowed to use anything in exam – textbooks, study materials, class notes, laptop, mobile, the internet etc. You will be given 24 hours to finish the exam.

Tentative Dates:

- **Mid-Term Exam 1 – Mid-February**
- **Mid-Term Exam 2 – Mid-March**

(3) Final Project & Presentation (20%); Tentative Dates: **May**

Final Grading:

Grades	Significance	Overall Score
A	Superior	90 - 100
B+	Excellent	80 - 89
B	Very Good	70 - 79
C+	Good	60 - 69
C	Acceptable	50 - 59
D	Minimum	40 - 49
F	Fail/Inadequate	< 40

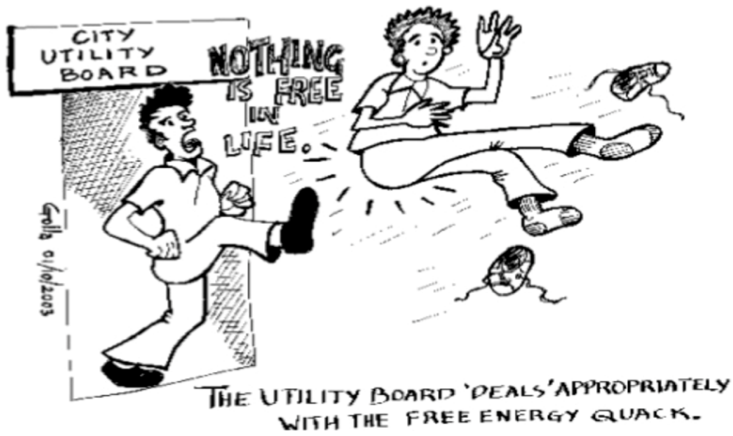
Tentative Timeline and Syllabus

Week	Topic
1 & 2	**Introduction and Basic Concepts** Thermodynamics and Energy, Importance of Dimensions and Units, Systems and Control Volumes, Properties of a System, Density and Specific Gravity, State and Equilibrium, Processes and Cycles, Temperature and the Zeroth Law of Thermodynamics, Pressure, Pressure Measurement Devices, Problem-Solving Technique
2 & 3	**Energy, Energy Transfer, and general Energy Analysis** Forms of Energy, Energy Transfer by Heat, Energy Transfer by Work, Mechanical Forms of Work, The First Law of Thermodynamics, Energy Conversion Efficiencies, Energy and Environment
4 & 5	**Properties of Pure Substances** Pure Substance, Phases of a Pure Substance, Phase-Change Processes of Pure Substances, Property Diagrams for Phase-Change Processes, Property Tables, The Ideal-Gas Equation of

	State, Compressibility Factor—A Measure of Deviation from Ideal-Gas Behavior, Other Equations of State
6 & 7	**Energy Analysis and Closed Systems** Moving Boundary Work, Energy Balance for Closed Systems, Specific Heats, Internal Energy, Enthalpy, and Specific Heats of Ideal Gases, Internal Energy, Enthalpy, and Specific Heats of Solids and Liquids
7 & 8	**Mass and Energy Analysis of Control Volumes** Conservation of Mass, Flow Work and the Energy of a Flowing Fluid, Energy Analysis of Steady-Flow Systems, Some Steady-Flow Engineering Devices, Energy Analysis of Unsteady-Flow Processes
9, 10 & 11	**The Second Law of Thermodynamics** Introduction to the Second Law, Thermal Energy Reservoirs, Heat Engines, Refrigerators and Heat Pumps, Perpetual-Motion Machines, Reversible and Irreversible Processes, The Carnot Cycle, The Carnot Principles, The Thermodynamic Temperature Scale, The Carnot Heat Engine, The Carnot Refrigerator and Heat Pump
12, 13 & 14	**Entropy** Entropy, The Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams Involving Entropy, What Is Entropy? The T ds Relations, Entropy Change of Liquids and Solids, The Entropy Change of Ideal Gases, Reversible Steady-Flow Work, Minimizing the Compressor Work, Isentropic Efficiencies of Steady-Flow Devices, Entropy Balance

Nothing is free in life! You have to work hard to shine in your life.

What is Free Energy?



(Picture from Web)